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VERBAL ORGANIZATION AND THE FACILITATION OF SERIAL LEARNING.

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THE VERBAL ORGANIZATION RELEVANT TO SERIAL LEARNING WAS STUDIED. NINETY-SIX FOURTH AND FIFTH GRADERS WERE REQUIRED TO LEARN THE ORDER OF ONE LIST OF 14 FAMILIAR NOUNS. THE CONDITIONS OF THE SERIAL TASK WERE PHRASE CONTROL, SENTENCE CONTROL, AND NOUN CONTROL. THE DEPENDENT VARIABLE WAS THE NUMBER OF CORRECT RESPONSES. A REPEATED MEASURES ANALYSIS OF VARIANCE WAS USED TO ANALYZE THE DATA. SUBJECTS WHO WERE EXPOSED TO THE SENTENCE CONTROL PERFORMED SIGNIFICANTLY BETTER THAN THOSE EXPOSED TO THE OTHER TREATMENTS. TABLES, A DISCUSSION, AND REFERENCES ARE INCLUDED. THIS PAPER WAS PRESENTED AT THE AMERICAN EDUCATIONAL RESEARCH ASSOCIATION CONFERENCE (CHICAGO, FEBRUARY 6-10, 1968). (BK)

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Verbal Organization and the Facilitation of Serial Learning[1]

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Abstract

Ninety-six fourth- and fifth-grade children participated in a serial learning experiment. Subjects were required to learn a 14-item serial list in either the traditional manner, or with the aid of individual phrases, or in the context of a single sentence. It was found that subjects who were given the single unifying structure, the sentence, performed significantly better than did subjects who learned under non-unified conditions. These results contradict those of an earlier experiment in which it was concluded that verbal organization does not facilitate performance in a serial task.

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RE001 136

Verbal Organization and the Facilitation of Serial Learning[1]

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Recently, considerable attention has focused on the question whether or not identical processes are involved in learning the serial order of items in a list and in learning the pair-wise arrangement of items in a list. The most frequently used method in attempts to answer this question has been that of transfer designs, either serial (Ser) to paired associate (PA) or PA to Ser. Although evidence thus far produced by the application of this method is not yet entirely conclusive, some investigators have construed available results as implying that the processes of Ser and PA learning do indeed differ. Jensen (1962), for example, has contended that the learning of a Ser list consists of the integration of a sequence of responses into a single unit rather than of the acquisition of connections between successive eliciting stimuli and their companion responses. Adopting this contention (1965a), Jensen and Rohwer (1965b) have gone on to characterize one of the differences between Ser and PA learning in terms of the relative importance of past verbal experience for the two kinds of learning: "In short, we hypothesize that PA learning ability reflects relatively more the richness of the S's past verbal experience and its spontaneous availability in a learning situation, while serial learning constitutes a more fundamental kind of ability which is relatively unaffected by the amount of previous verbal experience (Jensen & Rohwer, 1965b, p. 602)."

The purpose of the present experiment is to disentangle the hypothesis of response integration as a description of Ser learning and the assertion

that the availability of previous verbal experience is irrelevant to the efficiency of Ser learning. The validity of the latter hypothesis depends, in part, on the results of a study (Jensen & Rohwer, 1965b) conducted to test one of its implications, namely, that verbal organization of PA items should facilitate acquisition whereas verbal organization of Ser items should not. The tasks of learning a ten-pair PA list and a 10-item Ser list were given to children of a variety of grade levels. In the case of both tasks, the treatment and control conditions were distinguished only by the procedure followed on the initial study trial. For the latter, the PAs and the Ser items were simply shown successively and the S was asked to name the object in each picture as it was shown to him. In the treatment condition for the PA task, the S was asked to elaborate the names of the two objects in each pair into a sentence, one sentence per pair. Similarly, the treatment condition for the Ser task required the S to elaborate the names of each successive pair of objects into a sentence, two items per sentence. Note that this procedure is consistent with the conception that Ser learning consists of the acquisition of connections between successive items each of which serves both as a stimulus and as a response.

The results for elementary school children replicated those previously obtained for mentally retarded adults (Jensen & Rohwer, 1963): The sentence condition produced substantial facilitation of PA but not of Ser learning. Accordingly, the investigators concluded in favor of their original hypothesis regarding the irrelevance of verbal organization for Ser learning and went on to say: "If a true difference between the sentence and naming conditions were found to exist, we would be inclined to

interpret the difference as being attributable to facilitation of response learning rather than to facilitation of serial learning per se (P. 606)."

In contrast to these conclusions, the guiding hypothesis for the present study is that verbal organization is relevent to Ser learning but only if the type of organization imposed is consistent with what is ordinarily learned when a Ser list is acquired. In agreement with Jensen (1962) and with Jensen and Rohwer (1965a) it is assumed that the learning of a Ser list consists of the process of integrating the items into a single response. On this assumption, the absence of facilitation previously reported (Jensen & Rohwer, 1963, 1965b) would be expected; the kind of verbal organization used, that is, successive discrete sentences, is not consistent with what is presumably acquired in Ser learning. A different type of verbal organization, specifically, one that confers on all items in the Ser list membership in a single unit, would be expected to produce facilitation not accountable in terms of enhanced response learning. The present experiment was designed to test this prediction.

Method

Design and materials. All Ss were given a common task, namely, to learn the serial order of one or the other of two lists of fourteen familiar nouns. The design was a 6x2x2x4 factorial in which the factors were, respectively: conditions, lists, grades, and trials. The various conditions differed only with regard to the character of the one study trial during which the list was first presented; thereafter all were identical.

The six conditions may be viewed as an aggregation of an experimental and five control groups. The study-trial materials for the experimental or single sentence (SS) condition were constructed to conform with the

requirement that all of the items in the list be contained within the same verbal unit. Each of the fourteen nouns was presented in the context of a three- or four-word phrase. The critical property of the phrases was that when read in the prescribed order, they formed one continuous, meaningful sentence. Thus the study-trial materials for the SS condition were conceived to be a concrete expression of a verbal organization consistent with the interpretation of serial learning as a process of integrating a single response.

In order to answer the question of central interest, that is, whether or not SS would facilitate Ser learning, a noun control (NC) condition was used. The study-trial materials for NC simply consisted of the fourteen nouns in the list presented successively in accord with the traditional Ser procedure.

Since it was expected that learning would be more efficient in SS than in NC, an additional condition was necessary to permit an evaluation of an alternative interpretation of whatever facilitation was observed. Following Jensen and Rohwer (1965b) it might be argued that the verbal content in SS would affect response learning rather than the integration of the list as a unit. If so, it can be reasoned that the same effect would be produced by the presentation of each noun in the context of a phrase even when the phrases are independent of one another such that their seriation does not form a continuous sentence. Accordingly, in the phrase control (PC) condition, the study-trial materials consisted of a set of fourteen unrelated phrases, one for each of the nouns in the list. The PC condition served the added function of providing a comparison with SS in which noun study-time was equated, as was not the case with NC.

As a control for response learning, however, RC by itself was not entirely adequate since the particular words used in the verbal contexts were necessarily different than those used in SS. By way of obviating this difficulty, the same phrases used in SS were presented in a scrambled order in the scrambled sentence control (SSC) condition such that their succession did not form a sentence.

Note that although all of the words presented in SSC were identical with those in SS, the order of items in the list varied. Thus in order to evaluate directly the effects of SSC on serial learning, the remaining conditions in the design were simply scrambled versions of RC (SRC) and PC (SPC) where the order of the items in the list was the same as that in SSC. A complete set of the study-trial materials used for one of the lists is shown in Table 1.

Insert Table 1 about here.

The three remaining factors were: lists, grades and trials. Two distinct lists of nouns were used to reduce the risk that results would be specific to one set of items. Children were drawn from two grade levels rather than one only to provide a sample of adequate size, not to test hypotheses as to age differences.

Procedure. When S entered the room, E told him that he was to memorize a list of nouns (or nouns in phrases) in the order in which they were presented. The instructions described the procedures that would be followed in the study-trial and in the anticipation trials as well as the type and timing of the responses expected.

All materials were presented on a memory drum. Immediately after the instructions, the 16 successive nouns (or phrases) were shown at a

four-second rate and, as each one appeared, it was read aloud by E. Following the study trial an asterisk appeared and S had four seconds to supply the first noun. The first noun then appeared, and S had another four seconds to offer the second noun, and so on through the list to the end of the first anticipation trial. Three more anticipation trials were given for a total of four in all.

It is important to note that in all conditions, only the nouns themselves were presented during the four anticipation trials. In other words, Ss in the sentence and phrase conditions were given a verbal context only on the initial presentation trial.

Subjects. Ninety-six fourth- and fifth-grade children from a school serving a middle-class residential area participated in the experiment.[2] Forty-eight children from each grade were randomly assigned to the six experimental conditions. All Ss were tested individually by the experimenter (E).

Results

The dependent variable in this study was the number of correct responses given by S over the four anticipation trials. A repeated measures analysis of variance was performed on the data. The analysis of variance table is presented in Table 2. All hypotheses were tested with a probability of a

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Insert Table 2 about here.

Type I error equal to .05. It may be seen from Table 2 that there are three significant sources of variation, namely conditions, trials, and grades X trials.

The trials effect was expected, and accounts for about 57 percent of the within variance. The grades X trials effect may be traced to the slightly superior learning rate of Ss in the fifth grade.

It is of particular interest that there is no main effect for either grades or lists, and that none of the interactions involving these factors in the between portion of the table is significant. The mean number of correct responses per trial as a function of conditions and lists is presented in Table 3.

Insert Table 3 about here.

Within the main effect of conditions, Scheffé's method for post hoc comparisons reveals that the SS group differs from each of the other groups, and that no other pair-wise contrasts are significant. The sum of squares associated with the main effect of conditions accounts for 32.2 percent of the total between variability. The comparison, SS vs. the average of all other conditions combined, accounts for 567.67 or 91.5 percent of the total between conditions sum of squares, 620.26. The sums of squares for all other available orthogonal comparisons is 52.61 which, with four degrees of freedom, is not significant. As an inspection of Table 3 indicates, the results are clear; SS did facilitate learning relative to the ordinary serial procedure condition, NC, and the magnitude of facilitation was as great on trial 4 as it was across trials. The additional fact that NC produced as many correct responses as each of the other control conditions contraindicates an interpretation of the facilitory effect of SS in terms of an enhancement of response learning.

Discussion

The results of the present study support the initiating hypothesis, namely that verbal organization is relevant to the integration of a sequentially ordered set of responses. Even though this conclusion is in

direct opposition to that reached by Jensen and Rohwer (1965b) it is not inconsistent with their interpretation of serial learning as a process of response integration (Jensen & Rohwer, 1965a). Indeed, the present results may be construed as indirect evidence in support of that interpretation since the form of verbal organization employed follows from it.

A fruitful theory of what is learned in serial learning ought to have implications for the design of conditions to facilitate that process. The adequacy of the theory, then, depends, in part, upon whether or not the facilitative procedures that can be derived from it serve to increase learning efficiency. Although the present results are suggestive, they are not sufficient to permit a conclusive judgment in this regard. Accordingly, it is of some import to conduct a comparative experiment designed to assess the relative efficacy of facilitative conditions derived from the principal theories of serial learning.

The problem of the effect of SS on response learning deserves brief additional comment. In the present design, no provision was made for a direct assessment of the degree of response learning as a function of study-trial conditions. Nevertheless, it is difficult to discern in the SS phrases any properties relevant to the efficiency of response learning that are not also present in the PC phrases. Thus, our interpretation is that verbal organization of the appropriate type affects the process of serial learning directly.

Two other problems worthy of further investigation are suggested by the present results. The first concerns the effect of sentential organization on the form of the serial position curve. That is to say, it is pertinent now to examine in more detail the process of facilitating response

integration as reflected in the numbers of items learned per trial and in the order in which they are learned. If the verbal content provided is critically involved in this process, variations in sentence properties such as phrase structure should affect the magnitude and location of errors in learning. Through the application of a phrase-structure analysis, Johnson (1965) has achieved a remarkable degree of success in predicting the error frequencies in the learning of sentences as responses in a PA task. A similar application might prove fruitful in the case of serial learning.

Finally, since it has been demonstrated that the provision of a verbal organization containing all of the items in a serial list facilitates learning, it is of interest to determine the conditions under which positive transfer would occur. One approach to this goal would involve the manipulation of both training and instructional variables relevant to the use and generation of verbal organization in the learning of serial lists. The effectiveness of the manipulations could then be evaluated in terms of performance on a transfer task administered in accord with the usual method of serial anticipation.

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Footnotes

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Table 1

List A Materials

Single Sentence (SS)	Phrase Control (PC)	Noun Control (NC)
the grey CAT	the grey CAT	CAT
jumped over the LOG	we jumped the LOG	LOG
and crossed the STREET	I crossed the STREET	STREET
to find the BOWL	you find the BOWL	BOWL
of cold MILK	some cold MILK	MILK
under the CHAIR	his own CHAIR	CHAIR
in the new HOUSE	our nice new HOUSE	HOUSE
by the blue LAKE	a little blue LAKE	LAKE
where the young BOY	my fine young BOY	BOY
lost his left SHOE	he lost his SHOE	SHOE
while eating the FISH	she's eating the FISH	FISH
on the wooden BOAT	an old wooden BOAT	BOAT
during the STORM	that awful STORM	STORM
that came last YEAR	they came last YEAR	YEAR

Scrambled Sentence Control (SSC)	Scrambled Phrase Control (SPC)	Scrambled Noun Control (SNC)
that came last YEAR	they came last YEAR	YEAR
the grey CAT	the grey CAT	CAT
of cold MILK	some cold MILK	MILK
where the young BOY	my fine young BOY	BOY
and crossed the STREET	I crossed the STREET	STREET
on the wooden BOAT	an old wooden BOAT	BOAT
lost his left SHOE	he lost his SHOE	SHOE
to find the BOWL	you find the BOWL	BOWL
while eating the FISH	she's eating the FISH	FISH
jumped over the LOG	we jumped the LOG	LOG
in the new HOUSE	our nice new HOUSE	HOUSE
under the CHAIR	his own CHAIR	CHAIR
during the STORM	that awful STORM	STORM
by the blue LAKE	a little blue LAKE	LAKE

Table 2

Analysis of Variance Table

Source	d/f	SS	MS	F
Between Ss	95	1928.64	20.30	
Grades	1	6.51	6.51	----
Conditions	5	620.28	124.06	8.28*
Lists	1	20.17	20.17	1.35
G X C	5	49.55	9.91	----
G X L	1	1.04	1.04	----
C X L	5	122.08	24.42	1.63
G X C X L	5	30.64	6.13	----
Error	72	1078.37	14.98	
Within Ss	288	1456.49	5.06	
Trials	3	827.72	275.91	128.33*
G X T	3	19.84	6.61	3.07*
C X T	15	40.91	2.73	1.27
L X T	3	16.27	5.42	2.52
G X C X T	15	23.59	1.57	----
G X L X T	3	5.02	1.67	----
C X L X T	15	19.48	1.30	----
G X C X L X T	15	38.54	2.57	1.20
Error	216	465.12	2.15	
Total	383	3385.13	8.84	

* $p \leq .05$

Table 3

Mean Numbers of Correct Responses

across Trials and on Trial 4.

Lists	Conditions						
	SS	NC	FC	SSC	SNC	SFC	All
A	7.62	5.06	4.19	5.25	5.62	3.91	5.28
B	7.90	5.19	4.38	2.84	4.03	4.56	4.82
Across Trials	7.76	5.12	4.28	4.05	4.83	4.23	5.05
Trial 4	10.12	7.25	6.00	5.75	6.90	5.44	6.84